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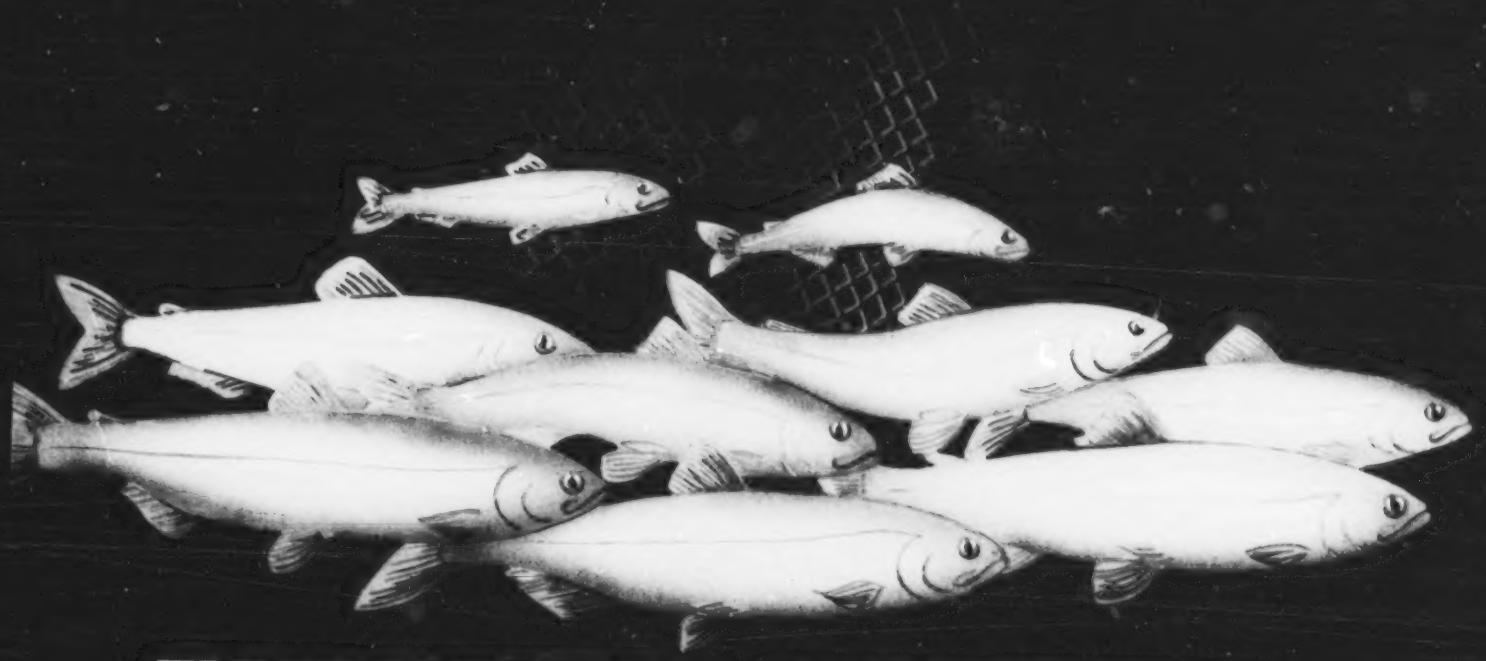

ENVIRONMENTAL MANAGEMENT OF MARINE FISH FARMS

British Columbia
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BC MINISTRY OF ENVIRONMENT

MINISTRY OF ENVIRONMENT

PROVINCE OF BRITISH COLUMBIA

ENVIRONMENTAL MANAGEMENT OF MARINE FISH FARMS

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This document, the **Environmental Management of Marine Fish Farms**, summarizes environmental practices and regulatory procedures required by the B.C. Ministry of Environment (MoE) for marine finfish netcage aquaculture operations on the B.C. coast.

Copies are being sent to all farm operators. Please add it to the binder containing the MoE **Environmental Monitoring Program for Marine Fish Farms**, monitoring data sheets and ***Aquaculture Waste Control Regulation***, previously distributed to all operators.

Note :

This document summarizes and interprets certain legal obligations pertinent to the *Waste Management Act* and other legislation. If there is any discrepancy between this document and such legislation, the actual legislation shall take precedence. The policies and procedures stated here are subject to revision.

TABLE OF CONTENTS

	Page
1. INTRODUCTION	3
2. MINISTRY OF ENVIRONMENT ROLES AND RESPONSIBILITIES	
2.1 MoE MANDATE	6
2.2 MoE PREOPERATIONAL REVIEW	6
2.3 MoE OPERATIONAL REQUIREMENTS	
a) Waste Management Regulations	7
b) Reporting and Monitoring Requirements	8
3. ENVIRONMENTAL MANAGEMENT	
3.1 STORAGE AND DISPOSAL OF UNMARKETABLE FISH AND BLOOD	
3.1.1 ON-SITE STORAGE	10
3.1.2 DISPOSAL OF UNMARKETABLE FISH AND BLOOD	11
3.2 STORAGE AND HANDLING OF FISH FEED, AND MANAGEMENT OF WASTE FEED AND FISH FAECES	
3.2.1 MANAGEMENT OF WASTE FEED AND FISH FAECES	14
3.2.2 STORAGE AND HANDLING OF FISH FEED	15
3.3 DISPOSAL OF DOMESTIC SEWAGE	16
3.4 STORAGE AND DISPOSAL OF REFUSE	17
3.5 TRANSPORTATION, STORAGE AND DISPOSAL OF TOXIC MATERIALS	19
3.6 USE OF PESTICIDES IN MARINE FISH FARMING	20
3.7 WILDLIFE AND FISHERIES IMPACTS	
3.7.1 PREVENTION OR MITIGATION OF WILDLIFE PROBLEMS	21
3.7.2 CONTROL OF PROBLEM WILDLIFE	22
3.7.3 LOCATION OF MARINE FISH FARMS WITH RESPECT TO RECREATIONAL FISHERIES HABITAT	23
3.8 IMPACTS ON SURFACE FRESH WATER SUPPLIES	24
FIGURES	
FIGURE 1 POSSIBLE ENVIRONMENTAL IMPACTS ASSOCIATED WITH MARINE FISH FARMING	5
FIGURE 2 PERMITTING AND MONITORING REQUIREMENTS	8
FIGURE 3 ENVIRONMENTAL MONITORING PROGRAM SCHEDULES	9
APPENDIX	
MINISTRY OF ENVIRONMENT REGIONAL OFFICES	25

1. INTRODUCTION

The B.C. Ministry of Environment (MoE) supports the orderly, environmentally responsible development of marine fish farming in British Columbia. MoE has a mandate to protect and manage marine environmental quality, recreational fisheries and shellfisheries, wildlife and fresh water resources which may be used or affected by marine fish farming. It is the responsibility of MoE to ensure that marine fish farms are and will continue to be operated in a manner that is compatible with these coastal resources and uses.

The recent and rapid growth of marine fish farming in B.C. has raised concerns from other coastal resource users, public interest groups and government agencies about possible negative environmental effects. Documented environmental impacts of this industry have been low compared with other waste generating activities along the B.C. coast, and the Ministry of Environment considers that the potential for serious impacts will remain low, based on available evidence. Marine fish farms are themselves sensitive to environmental degradation, and rely on good water quality to ensure farm success. Potential localized environmental impacts which might occur due to poor siting or because of unacceptable farm practices are depicted in **Figure 1**. These impacts are not expected to occur at a well sited farm employing environmentally responsible farm practises and operating in compliance with MoE requirements.

This document, the **Environmental Management of Marine Fish Farms**, is intended to assist farm operators to avoid or minimize environmental impacts. It outlines MoE regulatory requirements and procedures which should be followed by all operators. Together with the Ministry's **Environmental Monitoring Program for Marine Fish Farms** and the ***Aquaculture Waste Control Regulation***, it should help to ensure that environmental concerns under MoE jurisdiction are addressed and the industry is treated by MoE in a manner which is fair and consistent with other waste generating coastal activities. MoE emphasizes appropriate siting, acceptable waste management and other operational practices, and environmental monitoring at all farms to determine whether or not environmental impacts are occuring or are likely to occur. In addition, MoE is engaged in or supporting several studies into potential environmental impacts associated with marine fish farming.

Please note the following points regarding this document:

1. The MoE regulations and procedures summarized in this document apply to on-site activities at new and existing marine finfish netcage operations and off-site activities such as unmarketable fish ("mort") disposal from such operations. They do not apply to environmental management of freshwater or land based fish farming, hatcheries and fish processing facilities.

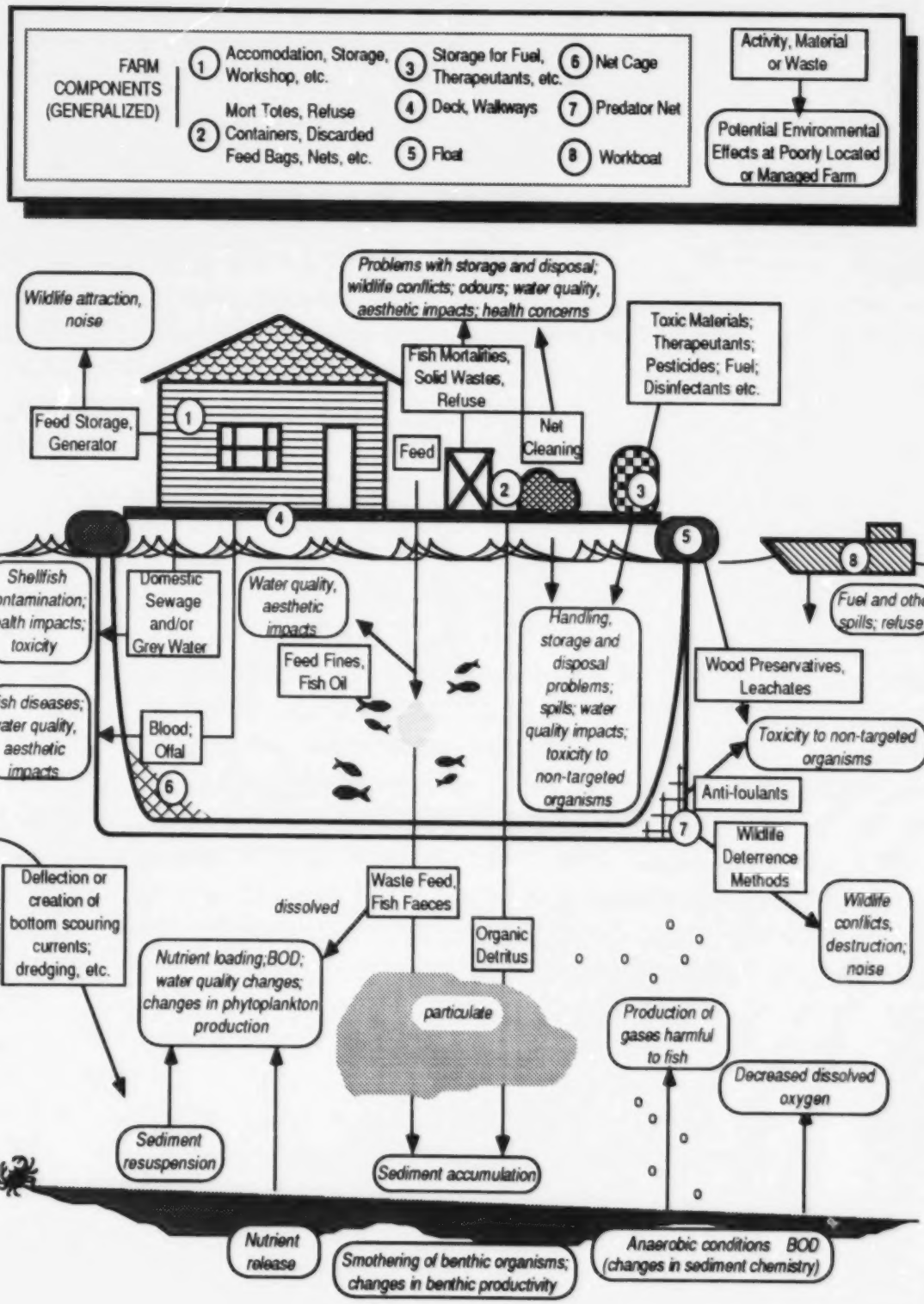
2. The document addresses only those environmental issues which come under MoE jurisdiction. The focus is on acceptable waste management practices, both on and off-site. Adherence to these practices should protect marine water quality, wildlife, recreational fisheries and fresh water resources and uses (including fish farm stocks!) from possible waste impacts.

3. The Ministry of Environment considers proper biophysical location to be the most important way of avoiding or minimizing any operational impacts. However, this document is concerned with operational practices rather than pre-operational site selection and evaluation, since the latter is already addressed by the Aquaculture Referral Process co-ordinated by the B.C. Ministry of Crown Lands, and the Aquaculture Licence application process of the B.C. Ministry of Agriculture and Fisheries.

4. This document complements the B.C. Salmon Farmers Association **"Codes of Practice for the Husbandry and Welfare of Farmed Fish"**, Department of Fisheries and Oceans draft **"Federal Guidelines for Aquaculture in British Columbia"**, Ministry of Crown Lands **"Guidelines for Allocation of Crown Land for Aquaculture"**, and several Ministry of Agriculture and Fisheries publications (*e.g.* **"Aquaculture in B.C. - Getting Started"**, **"Biophysical Criteria for Siting Salmon Farms in British Columbia"**).

5. The MoE requirements and procedures covered by this document will be reviewed in three years.

FIGURE 1 - POSSIBLE ENVIRONMENTAL IMPACTS ASSOCIATED WITH MARINE FISH FARMING


FARM COMPONENTS (GENERALIZED)
1 Accomodation, Storage, Workshop, etc.
2 Mort Totes, Refuse Containers, Discarded Feed Bags, Nets, etc.
3 Storage for Fuel, Therapeutants, etc.
4 Deck, Walkways
5 Float
6 Net Cage
7 Predator Net
8 Workboat
Activity, Material or Waste
Potential Environmental Effects at Poorly Located or Managed Farm
Wildlife attraction, noise
Problems with storage and disposal; wildlife conflicts; odours; water quality, aesthetic impacts; health concerns
Toxic Materials; Therapeutants; Pesticides; Fuel; Disinfectants etc.
Fish Mortalities, Solid Wastes, Refuse
Feed Storage, Generator
Feed
Net Cleaning
Shellfish contamination; health impacts; toxicity
Domestic Sewage and/or Grey Water
Water quality, aesthetic impacts
Handling, storage and disposal problems; spills; water quality impacts; toxicity to non-targeted organisms
Fuel and other spills; refuse
Wood Preservatives, Leachates
Feed Fines, Fish Oil
Fish diseases; water quality, aesthetic impacts
Blood; Offal
Toxicity to non-targeted organisms
Anti-foulants
Wildlife Deterrence Methods
Deflection or creation of bottom scouring currents; dredging, etc.
Waste Feed, Fish Faeces
dissolved
Organic Detritus
Wildlife conflicts, destruction; noise
Nutrient loading;BOD; water quality changes; changes in phytoplankton production
particulate
Production of gases harmful to fish
Decreased dissolved oxygen
Sediment resuspension
Sediment accumulation
Nutrient release
Smothering of benthic organisms; changes in benthic productivity
Anaerobic conditions BOD (changes in sediment chemistry)

2. MINISTRY OF ENVIRONMENT ROLES AND RESPONSIBILITIES

2.1 MOE MANDATE

The Ministry of Environment has statutory responsibilities to protect resources such as water quality, water quantity, recreational fisheries and wildlife, and to control any impacts of marine finfish aquaculture, according to provisions of the ***Environment Management Act, Waste Management Act, Water Act, Wildlife Act*** and ***Pesticide Control Act***, and the federal ***Migratory Birds Convention Act***. Management responsibility for recreational fisheries is shared with the Department of Fisheries and Oceans Canada under the federal ***Fisheries Act***. The **B.C. Finfish Aquaculture Inquiry** (December, 1986) identified the need for environmental monitoring to ensure environmentally acceptable development of the marine fish farm industry. The **Environmental Management of Marine Fish Farms**, together with the MoE **Environmental Monitoring Program for Marine Fish Farms** and the ***Aquaculture Waste Control Regulation***, were prepared in response to this recommendation.

2.2 MOE PREOPERATIONAL REVIEW

The **Aquaculture Referral Process** is coordinated by the B.C. Ministry of Crown Lands (MCL) and applies to all new farms before any decision to grant tenure has been made. **Land Referrals** are routinely circulated by the MCL to MoE Regional Offices (and other resource agencies and interest groups) for review and comment. This process gives MoE an opportunity for preoperational review, advice and direction in order to identify, reduce or avoid potential environmental impacts. Major changes (*e.g.* expansions) at operating farms are also dealt with through the Aquaculture Referral Process. The new **Aquaculture Licence Process** coordinated by the B.C. Ministry of Agriculture and Fisheries (MAF) should afford similar opportunities for MoE preoperational review.

Information on biophysical conditions and resources at the proposed site, proposed waste practices and related farm design, operation and production are among the requirements of the **Marine Fish Farm Development Plan** used to support applications to MCL for Crown aquatic tenure and to MAF for Aquaculture Licences. Copies of the Plan are available to participants in the Aquaculture Referral and Aquaculture Licencing processes. MoE has an opportunity to advise Crown Lands, Agriculture and Fisheries and the proponent whether a respective application should be approved, denied, or contains insufficient information for a proper assessment. MoE bases its advice on available information and considerations such as biophysical evaluation, site suitability relative to habitat protection concerns, potential recreational fisheries and wildlife conflicts, and the adequacy of proposed waste practices and other forms of environmental mitigation. The referral process also can be used to provide the applicant with early notification about a number of MoE operational requirements, such as :

- appropriate MoE regulations and environmental guidelines;
- the need to apply for necessary Waste or Water Permits, Licences or Approvals;

- environmental monitoring requirements; and,
- any terms and conditions for a specific aquaculture proposal.

MoE has also participated in a series of **Coastal Resource Interest Studies** coordinated by the MCL. These studies identified potential resource or user conflicts that need to be considered when siting marine fish farms. Biophysical evaluation, site selection and conflict resolution at the **Aquaculture Referral Process** stage and information from **Coastal Resource Interest Studies** are used to ensure that new farms are directed to areas where they will have minimum environmental impact.

2.3 MOE OPERATIONAL REQUIREMENTS

The following describes recent initiatives under the authority of the ***Waste Management Act*** which pertain to marine fish farm operations, including regulations, waste permitting and environmental monitoring requirements.

a) Waste Management Regulations

In general, the ***Waste Management Act*** requires **Waste Permits** or **Approvals** for any waste discharges (effluents, sewage, solids, *etc.*) to B.C. receiving waters, land or air unless specifically exempted under the ***Act*** and / or ***Waste Management Regulations***.

An ***Aquaculture Waste Control Regulation*** was enacted in December, 1988 under **Section 35** of the ***Waste Management Act*** . The ***Regulation*** stipulates that all marine netcage aquaculture operators must:

- undertake an environmental monitoring program;
- submit any additional information requested by the Regional Waste Manager and notify him about changes in the operation or occurences of pollution;
- take remedial action to deal with or prevent pollution; and,
- make contingency plans for fish mortalities.

The ***Aquaculture Waste Control Regulation*** exempts all operations using less than 630 tonnes of dry feed per year from requiring a Waste Permit or Approval for the release of waste feed and fish faeces, provided the conditions of the ***Regulation*** are followed. It also exempts domestic sewage discharge from the need for a Waste Permit or Approval depending on the quantity, treatment and method of disposal. Marine fish farms which exceed the size limit for feed (*i.e.* new large farms and expansions of existing small farms) or vary from the requirements for the discharge of treated domestic sewage must obtain a Waste Permit or Approval. Management of other wastes must follow usual procedures under the ***Waste Management Act***, including any permitting needs. Waste permitting requirements for the different feed usage categories are summarized in **Figure 2**.

FIGURE 2

PERMITTING AND MONITORING REQUIREMENTS

Annual Feed Usage (tonnes - dry)	Annual Feed Usage (tonnes - 10% moist)	Monitoring Schedule	Permit for Feed / Faeces	Permit for Domestic Sewage	Other Waste Permits *
up to 120	up to 134	A	Exempt	Exempt	May Be Required
120 - 630	134 - 700	B	Exempt	Exempt	May Be Required
above 630	above 700	C	Required	Exempt	May Be Required

* *e.g.* Landfill

Note : Exemptions are subject to the conditions specified in the ***Aquaculture Waste Control Regulation***

Where necessary, permit requirements will be set by the Regional Waste Manager. In general, the applicant for a Waste Permit or Approval would be expected to demonstrate that waste feed and faeces from a large (>630 tonne) operation was not having or likely to have significant environmental impacts on the marine environment. Consequently, permit requirements may include a site appraisal undertaken by the operator (*e.g.* biophysical site characterization, bottom survey, waste practices and other information required by the Regional Waste Manager), a site inspection by Regional Waste, and data analyses (including comparison with any preoperational data) before a Waste Permit or Approval were issued. If such assessment indicated significant waste management problems, issuance of the Waste Permit or Approval could be subject to remedial action or denied, or the problems could be dealt with by other means under the ***Waste Management Act***.

A copy of the ***Aquaculture Waste Control Regulation*** is included in the **Environmental Monitoring Program for Marine Fish Farms** distributed to farm operators and other interested parties. Additional copies of the ***Regulation*** may be obtained from Regional Waste Management offices.

b) Reporting and Monitoring Requirements

An **Environmental Monitoring Program for Marine Fish Farms** (distributed to farm operators for implementation in July 1989) specifies the environmental monitoring referred to in the ***Aquaculture Waste Control Regulation***. These monitoring requirements must be met unless amended by the Regional Waste Manager. Monitoring and reporting requirements are summarized in **Figure 3.**

FIGURE 3
ENVIRONMENTAL MONITORING PROGRAM SCHEDULES

SCHEDULE A

Quarterly Reports	Annual Report	Report Once
Summarize feed use, materials accounting, production, mortalities, wastes ...	N/A	N/A

SCHEDULE B

Quarterly Reports	Annual Report	Report Once
Summarize feed use, materials accounting, production, mortalities, wastes ...	Dive survey only if depth < 30 meters.	One month current direction & velocity, initiated within 2 years.
N/A	Monthly AM temp / D.O. (April - Sept.) up and downstream.	One year of monthly temp / salinity, initiated within 3 months.

SCHEDULE C

Quarterly Reports	Annual Report	Report Once
Summarize feed use, materials accounting, production, mortalities, wastes ...	Dive survey using transects if depth < 30 meters. Deploy sediment traps for one month if > 30 meters.	One month current direction & velocity, initiated within 2 years.
Monthly temp / salinity / D.O. (AM / PM) up and downstream.	N/A	N/A
Monthly ammonia, Nitrate + Nitrite.	N/A	N/A

As described under the Ministry of Crown Lands **Guidelines for Allocation of Crown Land for Aquaculture**, environmental monitoring and compliance with environmental management objectives are conditions of the Crown aquatic tenure for fish farm development under the B.C. ***Land Act***, in addition to being conditions of the ***Aquaculture Waste Control Regulation***. Problems such as non compliance with Permit conditions, unacceptable waste disposal practices and associated environmental impacts may be identified through monitoring, consultations with other agencies, public complaints or site inspections. Problems can be resolved through discussion between the Regional Waste Manager and the farm operator, and if necessary, enforcement under the ***Waste Management Act*** and/or consultation with the Regional Lands Manager regarding any corrective action under the ***Land Act***.

3. ENVIRONMENTAL MANAGEMENT

The following provides direction to farm operators on acceptable waste management and other procedures to avoid or mitigate environmental impacts. It describes the activity and potential impacts associated with each environmental concern, any MoE regulatory requirements, recommended practices and other considerations. Farm operators should discuss specific waste management and other MoE regulatory requirements with the appropriate MoE Regional Office (see Appendix for contacts).

3.1 STORAGE AND DISPOSAL OF UNMARKETABLE FISH AND BLOOD

Environmental Concerns

Storage and disposal of unmarketable fish and blood represents an important waste management concern. Routine mortalities may result in accumulations of significant quantities of organic wastes over a long period. Major losses (*e.g.* due to disease outbreak or a plankton bloom) occur infrequently, but may generate tonnes of dead fish within a short period. In either case, there is a need to anticipate and manage these wastes in an environmentally acceptable fashion (see below). Improper storage and disposal of dead fish may result in visual and odour problems, wildlife attraction, and possible disease transfer to wild and reared fish stocks.

Current "***Regulations for Processing Farm Fish***" (published jointly by the Ministry of Agriculture and Fisheries and Department of Fisheries and Oceans Canada) state that fish farmers may stun, bleed and ice fish on-site. However, any marine disposal of water contaminated with blood (on-site or during transportation off-site) raises concerns about possible transfer of fish diseases, organic loading and effects on water quality.

3.1.1 ON-SITE STORAGE

MoE Requirements

The temporary on-site storage of fish remains (including blood) shall be carried out in an environmentally acceptable manner that prevents nuisance odour problems, risk of spillage and attraction of wildlife.

Where immediate disposal is not possible, there must be sufficient on-site temporary storage capacity to handle routine fish remains and additional capacity to accommodate larger infrequent volumes due to disease, plankton or other large-scale losses. On-site temporary storage of dead fish and / or blood (prior to off-site transportation and disposal) should be done in a manner which prevents problems or complaints with respect to spillage, health, odour, aesthetics or wildlife attraction.

The use of tote containers with lids, or sealed holding tanks, are recommended for storage and transportation of fish remains. These must be emptied regularly. The maximum length of time for temporary on-site storage, prior to pick up by a collection service or other means of transportation for authorized off-site disposal, should be one week in summer and one month in winter since disease outbreaks peak during the summer and plankton-related mortalities are higher during early spring and late autumn. If fish remains are intended to be used for resource recovery (see below), then more frequent collection or treatment (*e.g.* preservation, acidification) may be necessary to ensure that they are acceptable for rendering or for other processing.

3.1.2 DISPOSAL OF UNMARKETABLE FISH AND BLOOD

MoE Requirements

1) If possible, resource recovery following physical, chemical or biological waste treatment should be examined as a preferred alternative to waste disposal of finfish remains.

2) Otherwise, acceptable disposal methods for unmarketable finfish remains (including blood) from a marine fish farm operation, associated harvesting or collection service are as follows:

a) where not in conflict with Ministry or Regional policy, by landfill for which a Waste Permit or Approval has been issued; or,

b) where not in conflict with Ministry or Regional policy, by discharge to the ocean of properly disinfected and treated remains for which a Waste Permit or Approval has been issued; or,

c) by incineration in a properly designed auxiliary fuel-fired incinerator for which a Waste Permit or Approval has been issued.

2) Ocean disposal of untreated dead fish and blood is not an environmentally acceptable practice, and is prohibited.

4) Methods for routine disposal of dead fish and blood, and location of any off site disposal must be reported under the mandatory environmental monitoring program. In addition, the *Aquaculture Waste Control Regulation* requires that the farm operator must prepare, and have approved by the Regional Manager, a contingency plan to be followed during a major fish kill, including the method of disposal of mortalities.

I) Resource Recovery

The best strategy for dealing with large numbers of dead fish from marine fish farms, and at the same time minimizing environmental and social concerns, is to regard them as a resource rather than a waste. Physical, chemical or biological treatment of fish remains, such as composting, ensilage and reducing, can produce beneficial products such as soil conditioners, fertilizer or oil, and can represent an opportunity for

economic diversification for the industry. The Ministry of Environment encourages investigation by the aquaculture industry into such methods of dealing with fish remains. Waste Permits or Approvals may be required where these methods involve waste products requiring disposal, in order to ensure acceptable practices and regulate waste discharges. Such discharges may have to comply with Waste Management Objectives for the Food Processing Industry (see "***Pollution Control Objectives for Food-processing, Agriculturally Oriented, and Other Miscellaneous Industries of British Columbia***"). A pending ***Agriculture Waste Control Regulation*** (to be issued by the Waste Management Branch) will include requirements for use or disposal of aquaculture wastes on farmland.

II) Land Disposal

Unauthorized disposal of unmarketable fish remains on Crown foreshore or Crown upland is a form of trespass under the B.C. ***Land Act***. Land disposal in remote areas can result in wildlife problems such as bear-human interactions, ingestion of potential toxicants, and creation of "artificial" populations of scavengers dependent on dumps as a main food source. Common wildlife control practices at organic landfills, such as lime treatment, burying or fencing, are generally ineffective or (in the case of liming) potentially unsafe wildlife deterrents. In populated areas, authorized disposal in municipal landfills is viewed as a temporary measure, but is not a satisfactory long-term solution due to unsuitable dump locations, capacities or designs, which may result in wildlife attraction and pollution. Concerns include odours, potential contamination of surface and ground waters, and possible safety considerations if bears are attracted.

Commercial collection services pick up unmarketable fish (and other farm wastes) in some developed areas (*e.g.* Sechelt Inlet and Campbell River areas). The Ministry of Environment encourages this practice. In some cases, these wastes have been shipped to a municipal landfill authorized for their disposal. However, again it must be emphasized that long term municipal landfill disposal may be unacceptable to Waste Management or local authorities. An alternative solution could be to develop one or more landfills or composting sites specifically for the disposal of unmarketable fish remains. These could be co-operatively operated, located on private land, and available to a number of farms in a given area. Such facilities would have to be sited and operated in a manner consistent with wildlife, water quality, health and aesthetic concerns, and may require a Waste Permit or an Approval. The Waste Management Branch should be consulted regarding requirements for landfills.

III) Ocean Disposal

Disposal of untreated dead fish and blood into marine waters is unacceptable because of public concerns, aesthetics, and potential disease transfer between farmed and wild stocks. Legal restrictions and controls, largely under Federal ***Fisheries Act*** jurisdiction, regulate the disposal of dead fish and remains in marine waters. Ocean disposal following treatment which includes disinfection may be

acceptable under certain circumstances, but will require a Waste Permit or Approval.

Iv) Incineration

Usual methods of commercial incineration are ineffective and uneconomical for fish disposal, and may result in smoke and odour complaints. Additional studies and technological advances are required for cost-effective, efficient and environmentally acceptable incineration of fish. Any proposal to incinerate fish as a waste management practice should be fully evaluated by the proponent and the Regional Waste Manager, and will require a Waste Permit or an Approval.

3.2 STORAGE AND HANDLING OF FISH FEED, AND MANAGEMENT OF WASTE FEED AND FISH FAECES

Environmental Concerns

Sediment accumulation from uneaten feed and fish wastes is a waste management concern. Marine fish farm operations generate significant amounts of waste feed and fish faeces. At a poorly sited farm, these organic wastes may accumulate on the seafloor and cause changes in local sediment chemistry and benthic life, and possibly affect local water quality. Farmed fish and other sensitive resources and uses may in turn be affected.

Other concerns with respect to feed are the occurrence of floatable solids and oils, depending on the type, composition, storage and handling of feed used. Such material may accumulate along shorelines, generating complaints about aesthetic pollution, and be a minor source of local nutrient loading and sediment accumulation problems. Wildlife attraction to improperly stored feed may also be a problem.

3.2.1 MANAGEMENT OF WASTE FEED AND FISH FAECES

MoE Requirements

1) **Waste feed and fish faeces from marine net cage operations can be managed in the following ways to protect pen-reared fish, marine water quality, and the marine benthic environment:**
   - **(a) by implementation of necessary corrective measures in farm husbandry (*e.g.* changes in feeding practices or total biomass) to reduce the rate and amount of accumulation of fish feed and faecal wastes; or,**
   - **(b) by movement of net-cages within tenure boundaries to prevent excessive accumulations of organic waste deposits (*i.e.* use of fallow areas).**
2) **Methods of waste feed and fish faeces management such as collection, dredging and dispersion of sediments may involve undesirable environmental consequences. Proposals should be referred to the Regional Waste Manager prior to implementation. Waste Permits or Approvals may be required for such activities.**

Sediment accumulation from waste feed and fish faeces at marine farms in B.C. will vary depending on site conditions and husbandry practices. The Ministry of Environment would prefer to emphasize site selection, source control and prevention to minimize sediment accumulation. Once tenure is approved and a farm becomes operational, environmental monitoring at the site will help to identify any potential or existing sediment accumulation problem and assist in determining the nature and level of mitigation required. Measures that should be encouraged involve husbandry and operational changes such as pen rotation (*e.g.* fallow areas), reduction in stocking densities, improved feeding techniques to reduce wastage, *etc.* When fallowing, pens should be moved before excessive organic accumulations occur, in

order to expedite site recovery. A site with moderate accumulations may recover fairly rapidly, whereas a severely impacted site may take several years to recover.

Other methods of sediment control and removal which might be considered at marine fish farms (*e.g.* dredging, creation of scouring currents, and capture of settling wastes by collection bags) require site-specific examination both for practicality and for potential environmental impacts before they could be used. In some cases, they could provoke adverse environmental effects such as plankton blooms or hydrogen sulphide releases harmful to farmed fish, or raise concerns about habitat destruction or entrainment of wild fish. Such proposed methods should be referred to the Regional Waste Manager for site-specific review. Waste Permits or Approvals may be required. Protective or mitigative measures such as timing, location and screening (*e.g.* of suction intakes) may be imposed by appropriate agencies.

3.2.2 STORAGE AND HANDLING OF FISH FEED

MoE Requirements

The occurrence of floatable solids and scum from feed fines, floating feed and feed oil should be minimized.

Methods to limit the release of floatable solids from feed at marine fish farms may include using types of feed which contain fewer fines, and installing a feed-fine recovery system. Refer to the requirements for solid waste (refuse) disposal and prevention of wildlife problems regarding appropriate ways to store feed and dispose of empty feed bags.

3.3 DISPOSAL OF DOMESTIC SEWAGE

Environmental Concerns

Most marine fish farms in B.C. have domestic sewage facilities for a small number of employees, housed in a floating or adjacent upland commercial operation. Sewage produced from marine fish farms includes human wastes and grey water (wash water, drainwater). Untreated sewage wastes have human health and aesthetic implications for recreational use of affected marine waters or contamination of recreational and commercial shellfish. Drainwaters originating from floor drains and other fixtures may also contain cleaning or treatment solutions toxic to fish and other aquatic organisms. Any marine discharge of this sewage must be consistent with the protection and conservation of finfish and shellfish habitat and recreational resources.

MoE Requirements

1) **All management and disposal of domestic sewage originating from offshore or foreshore facilities on a fish farm must comply with conditions and circumstances specified under the *Aquaculture Waste Control Regulation*:**
2) **No sewage discharge shall be allowed if there are known or suspected commercial / recreational shellfish resources or recreational uses within 125 metres of the sewage outfall.**
3) **Proposed or actual methods for disposal of domestic sewage, and related information such as location of discharge, must be reported under the mandatory environmental monitoring program.**

The ***Aquaculture Waste Control Regulation*** exempts marine discharge of domestic sewage of less than 2.5 m^3 per day from requiring a Waste Permit or Approval, provided there is a two day retention time and the discharge is located at a depth greater than 15 m (please refer to the ***Regulation*** for details). This volume is equivalent to domestic sewage produced by ten people, and should cover the majority of operations. The exemption applies only to marine finfish net-cage operations located on the foreshore or on tidal saltwater, and has been granted because of the small volume of domestic sewage and remote locations involved for most operations, the large marine assimilative capacity, and the impracticality of requiring shore-based treatment and/or disposal at many locations (steep, rocky terrain).

Marine discharges greater than 2.5 m^3/day will require Waste Permit or Approval. Regardless of discharge volume, alternatives to marine discharge (as given in the ***Regulation***) may be preferable or required under site-specific circumstances.

3.4 STORAGE AND DISPOSAL OF REFUSE

Environmental Concerns

Refuse from fish farm operations and living accommodations include abandoned nets, empty feed bags, empty pesticide and other chemical containers, and domestic garbage. The improper disposal of refuse can result in bear attraction and other wildlife problems. In more populated areas, public complaints regarding litter, odour or visual nuisances may result from inadequate or improper waste handling methods.

MoE Requirements

1) **All refuse which result from marine fish farm operations or ancillary activities may be disposed of, where not in conflict with Ministry or Regional policy, by landfill for which a valid Waste Permit or Approval has been issued, is in effect and specifies refuse disposal.**
2) **In remote areas, domestic refuse may be disposed of by incineration in a properly designed, auxiliary fuel-fired refuse incinerator. A Waste Permit may not be required.**
3) **Temporary storage prior to disposal or transportation off-site to an incinerator or authorized landfill must be in a manner that does not attract wildlife, cause nuisance odours, or pollute. Disposal of refuse to marine waters is unacceptable.**

I) Recycling

MoE encourages the aquaculture industry to recycle empty feed bags rather than disposing of them by landfill or incineration, and to explore opportunities to recycle other solid wastes.

II) Ocean Disposal

Marine waters are not an acceptable place to dispose of refuse, as stipulated in the Federal ***Canada Shipping Act*** and ***Fisheries Act***, and under the Provincial ***Litter Act***.

III) Land Disposal

Disposal on Crown upland requires an appropriate Lease or Licence of Occupation from the Regional Lands Office and a Waste Permit or Approval from the Regional Waste Manager. In remote areas, upland disposal may not be acceptable to MoE due to potential wildlife impacts. An alternative approach (particularly in more populated areas) is transportation of refuse off-site by a commerical refuse collection service, provided the end-point for disposal has a Waste Permit or Approval. Such services are now available in some developed aquaculture areas.

Iv) Incineration

Some MoE Regional Offices have a general procedure requiring "all camps with less than 100 people,

located in bear habitat and without access to an authorized municipal landfill site, to incinerate their refuse on a daily basis" (**Operational Procedures for Refuse Disposal at Remote Camps to Eliminate Bear Problems**, MoE 1987). Section 11 (i) (c) (ii) of ***Waste Management Regulation 432/82*** exempts emissions from approved, properly designed refuse incinerators serving remote camps of less than 100 persons from requiring a Waste Permit. The Regional Waste Manager should be consulted for incinerator specifications and operating procedures. Residues from on-site incineration should be disposed of in an acceptable manner (this applies particularly to plastic feed bags).

Certain items (*e.g.* empty pesticide containers) should not be burned on-site, but should be separated for disposal (or recycling) off-site. The ***Special Waste Regulations*** should be consulted regarding disposal of such wastes.

3.5 TRANSPORTATION, STORAGE AND DISPOSAL OF TOXIC MATERIALS

Environmental Concerns

A variety of substances such as pesticides, disinfectants and therapeutants may be transported to and from, stored and used on marine fish farms. If improperly handled, applied or disposed, these represent a potential threat to the environment, farmed fish, non-target organisms, the applicator and the human consumer. Although quantities used on marine fish farms are generally quite small, it is important that potentially toxic substances are properly transported, stored, handled and applied (and empty containers disposed) so as to minimize the risk of spillage, contamination of marine or fresh waters and adverse effects on non-target organisms.

MoE Requirements

1) **The storage and transportation of potentially toxic materials and fuels must be in a manner that minimizes odour problems and risk of spillage.**
2) **Such materials must be used and handled correctly, and adequate precautions taken to avoid or minimize adverse effects on the environment.**
3) **Disposal of toxic substances and containers must be done in the manner prescribed by the *Special Waste Regulations*.**
4) **All potentially toxic materials used in conjunction with farm operations which may be directly or indirectly released to marine waters must be reported under the mandatory environmental monitoring program.**

The disposal of toxic materials and their containers must be in accordance with the ***Special Waste Regulations***. The transportation of toxic substances must comply with the federal ***Transportation of Dangerous Goods Act*** and regulations, and the provincial ***Transport of Dangerous Goods Act*** and regulations. Fuel storage and containment criteria may be found in the B.C. Petroleum Association "***Guidelines for Consumer Bulk Petroleum Product Storage and Handling Facilities***" (July 1984). Where applicable, a toxic spill response plan and spill containment measures may have to be prepared and submitted as part of a Waste Permit application. Reporting of potentially toxic substances which directly or indirectly enter marine waters, as required under the mandatory environmental monitoring program, will assist in this endeavor. Any toxic spills that do occur should be reported to the Provincial Emergency Program at 1-800-666-3456.

3.6 USE OF PESTICIDES IN MARINE FISH FARMING

Environmental Concerns

Pesticides which may be used in the marine fish farming industry include antifoulants, fungicides, parasiticides and wood preservatives. Their use by this industry is being documented in B.C., and appears to be low. Marine environmental effects, including fate, persistence and impacts on non-target organisms, are poorly understood. Research and testing is required to ensure efficacy, occupational and public safety, and environmental suitability before these substances may be registered for fish farming purposes.

MoE Requirements

(1) All registered pesticides identified under Schedules of the *Pesticide Control Act* regulations and directly or indirectly released to marine waters as a consequence of marine fish farm operations, must be applied by a Certified Applicator having a valid Use Permit issued under the *Pesticide Control Act*, and be used for the purposes described by the label instructions.

(2) Unregistered pesticides can be applied to water bodies only under a Special Use Permit.

I) Registered Pesticides

Registered pesticides require a Use Permit issued by the Pesticide Control Branch before they can be used, and can be applied only by certified users, or by uncertified assistants directly supervised by a certified operator.

II) Unregistered Pesticides

Unregistered pesticides can only be used within the conditions stated on a Special Use Permit. A Special Use Permit (usually for research purposes of an unregistered pesticide) may be issued if approved by the Pesticide Control Branch. Use of this permit is restricted to a certified applicator (usually a researcher). A Special Use Permit requires that a report be filed with the Pesticide Control Branch within a year following completion of the research project.

Potentially toxic substances (including pesticides) which are used in the course of marine farm operations and directly or indirectly released to marine waters must be reported under the mandatory environmental monitoring program. The "Transportation, Storage and Disposal of Toxic Materials" (above) covers acceptable ways to transport and handle pesticides, and dispose of their empty containers.

3.7 WILDLIFE AND FISHERIES IMPACTS

Environmental Concerns

Wildlife attraction to penned fish, feed and organic wastes is a problem for the industry, and a concern for Provincial wildlife management. Direct or indirect losses due to these animals can have a major effect upon the economic viability of a marine fish farm operation. Some of the potential predators of cage-reared fish include seals, sea lions, dogfish, herons, kingfishers, seagulls, otter, marten and mink. In addition to direct losses, fish may be stressed, resulting in delayed death or chronic effects such as reduced growth. Injuries and scale loss can promote bacterial infection. The attraction of bears to stored fish feed, domestic garbage and solid waste disposal sites is a serious safety concern.

From the Ministry's perspective, some active or passive methods of predator or scavenger deterrence can result in needless destruction of wildlife. Many of these wildlife species represent an economically significant resource for viewing, hunting, trapping and guiding activities, under Provincial wildlife management. The Ministry of Environment is responsible for protecting and enhancing this resource and is concerned about possible direct or indirect impacts of marine fish farming on wildlife. Most wildlife species are protected under federal and provincial laws (Federal ***Fisheries Act*** (re. marine mammals), ***Migratory Birds Convention Act***, and Provincial ***Wildlife Act***).

Provincial fisheries management is concerned primarily with potential impacts of marine fish farm operations on anadromous trout, their habitat and recreational use. Potential impacts include entrainment in fresh water withdrawals, loss of spawning and rearing habitat, disease transfer (two-way), loss of recreational fishing access and opportunities, *etc.* Waste management practices, both on and off-site, must avoid adverse changes in marine or fresh water quality which could affect recreational fisheries.

3.7.1 PREVENTION OR MITIGATION OF WILDLIFE PROBLEMS

MoE Requirements

All marine fish farms must incorporate, as part of farm siting, design and operation, measures to minimize wildlife conflicts. Non-destructive methods must be used to deter wildlife. The storage and disposal of fish feed, domestic garbage or other substances must not attract bears and other wildlife.

The Ministry of Environment emphasizes careful site evaluation and planning for potential wildlife conflicts, in order to avoid or minimize problems rather than having to deal with them operationally. The distribution and movements of many wildlife species or individual populations have been documented. For example, known sea lion rookeries and haulouts, or marine bird colonies, can be avoided.

Once a farm is in operation, there are a number of non-destructive methods to avoid conflicts with wildlife, including physical devices (such as nets) and good husbandry techniques. It is important that

such deterrents be employed before a wildlife problem develops. Heavy gauge seine (guard) nets hung around net cages may deter seals, sea lions and dogfish, but can also trap animals. For birds and small mammals, a visible, non-tangling and sturdy net can be strung over cages to prevent entry. Electric fences on the perimeter of the cage facilities may deter otters from entering them. Feed, fish remains and other organic material should be stored in secure, covered containers. Good housekeeping practices should prevail (*e.g.* prompt removal of morts from net cages). Dogs can be effective in preventing small mammals from coming on the farm site, provided appropriate dog control is maintained. Scaring devices such as underwater acoustic transponders may be effective. The use of surface noise-making devices should be discouraged since this method can disturb adjacent upland owners and recreational boaters. Off-site impacts on wildlife must be prevented or managed. For example, organic wastes should be disposed in a manner and location which does not attract or affect wildlife.

Bears represent a potentially serious concern to marine fish farm employees and facilities. In known bear areas where there is direct land access to facilities, it is important that feed stores, mort containers and fish pens are fenced and gated, and any refuse properly contained or removed from the site. Upland disposal of organic remains and refuse in remote areas may be unacceptable to the MoE because of potential problems with bears and other wildlife, and alternative methods of disposal may have to be undertaken.

Staff and publications of provincial and federal fisheries and wildlife agencies can provide advice on determining and avoiding potential wildlife conflicts, as well as dealing with predator problems on an operating farm. For example, the Wildlife Branch "***Aquaculture Operational Guidelines for Protection of Wildlife and Marine Animals***" and the Ministry of Agriculture and Fisheries **Information Bulletin on Predator Control** both detail methods to deter predators.

3.7.2 CONTROL OF PROBLEM WILDLIFE

MoE Requirements

Permits to capture or destroy problem wildlife will be issued by the Ministry of Environment under the *Wildlife Act* only where the Regional Fish and Wildlife Manager (or delegated authority) has been consulted, and in his opinion all reasonable efforts to minimize the attraction of wildlife have been made, and reasonable attempts at non-destructive means of predator control have failed.

Destruction of wildlife is legal only when authorized under the ***Wildlife Act,*** the ***Fisheries Act***, the ***Migratory Birds Convention Act***, or the ***B.C. Fishery (General) Regulations***. Despite reasonable efforts (as defined by the Regional Fish and Wildlife Manager or delegate) to prevent damage or losses to penned fish or fish farm stores and equipment, there is still the possibility that a persistent animal will continue to cause harm. The opportunity for the farm operator to protect the farm and its stock

by legally capturing or destroying the problem animal should be available, in consultation with and following the direction of the Regional Fish and Wildlife Manager or delegate. It is the general policy of the Ministry of Environment to issue permits only when all reasonable efforts to minimize the attraction of wildlife have failed.

The fish farm operator must report any episodes where animals protected under the above mentioned ***Acts*** have been identified as causing harm to pen-reared fish or to the farm operation despite reasonable efforts to prevent such occurrence. The operator should explain what efforts were taken. Additional reasonable steps to prevent or deter predation may be recommended by the Regional Fish and Wildlife Manager or delegate, or a Permit to remove or destroy the identified animal may be issued.

3.7.3 LOCATION OF MARINE FISH FARM OPERATIONS WITH RESPECT TO RECREATIONAL FISHERIES HABITAT

MoE Requirements

A marine fish farm must be located one kilometer or more from the mouth of a watercourse known, or suspected to have, steelhead or cutthroat trout populations of recreational importance.

The Department of Fisheries and Oceans Canada (DFO) requires that marine fish farms must be located one kilometre away from the mouth of a major salmon-bearing stream. This has been expanded by MoE to include small coastal streams harbouring only coastal cutthroat or steelhead trout populations of recreational importance. Such locations may be preferred by marine fish farm developers because they provide fresh water for various uses. Since anadromous trout may swim near or through net cages that are located adjacent to any spawning or rearing stream, a minimum separation distance is prudent to reduce risk of potential impacts due to disease transfer, water quality changes, *etc.*

Adequate care must be taken to protect fish and fish habitat when fresh water is withdrawn from a stream for farm use. Similarly, waste disposal methods and locations must ensure that wastes do not directly or indirectly enter watercourses, affecting fish or fish habitat. MoE staff will assess applications under the Aquaculture Referral Process and for Waste Permits and Water Licences for potential impacts on recreational fisheries. Advice and conditions on the Land Referral, Waste Permit or Water Licence may include requirements such as design changes (e.g. intake screening), maintenance of minimum flows, timing of fresh water withdrawals, location and treatment of wastes, *etc.*

Applications for Crown foreshore or offshore tenure will be assessed by MoE in case the physical presence of farm facilities or alignment of the aquaculture tenure boundary interfere with recreational fishing access and opportunities.

3.8 IMPACTS ON SURFACE FRESH WATER SUPPLIES

Environmental Concerns

The needs of all licenced users and environmental resources (*e.g.* fisheries) must be protected from possible impacts associated with marine fish farming. Surface fresh water requirements in marine fish farming may include domestic supplies, hatchery operations, equipment washing, hydroelectric generation, fish smolting, and mitigation of adverse environmental conditions (such as plankton blooms). Proposals may include storage, withdrawal, diversion or other changes in and about surface fresh water sources to meet these needs. Marine facilities may be located off stream mouths to take advantage of any natural fresh water lenses to promote smolting. Alternatively, fresh water may be delivered to lined smolt pens.

MoE Requirements

The B.C. *Water Act* requires that a marine fish farm operator must obtain a Water License or Approval from the Regional Water Manager before any withdrawal of surface freshwater from watercourses and/or waterbodies, or before any changes are made in and about any streams.

The ***Water Act*** allocates and regulates the use and diversion of surface water so that the environment and the rights of all licenced users are protected. Under the ***Water Act*** , a Water Licence or Approval is required to use (*i.e.* store, withdraw, divert or make changes in and about) water from a stream, lake or river for marine fish farming purposes. Farms generally are not located off large watercourses because of operational and husbandry problems created by debris, and temperature and/or salinity fluctuations. Surface withdrawals for farm purposes usually occur at or near the mouths of smaller watercourses and usually do not conflict with other fresh water users. On the other hand, since the farm is probably the final downstream user of fresh water in a given watercourse and farm operations are sensitive to changes in quantity of upstream sources, it is in the operator's interest to ensure his rights are protected. Holding a Water Licence or Approval provides this assurance under the ***Water Act.***

The protection of adult and juvenile salmonids and their habitat from adverse effects of surface water use is addressed through the MoE Water Licence application and Ministry of Crown Lands Aquaculture Referral processes (see above, "Location Of Marine Fish Farm Operations With Respect To Recreational Fisheries Habitat"). Applications are reviewed by MoE staff to ensure that fisheries and habitat under provincial management will not be affected by any storage, withdrawal or diversion. A Water Licence or Approval may specify the amount and timing of water use, and require adequate instream flows and appropriate design modifications (*e.g.* intake screening) in order to protect fisheries. No Water License or Approval will be required for farms which use natural fresh water lenses for smolting.

The Ministry may require floodproofing restrictions (such as set backs and height limits) for land-based facilities in areas where there are natural flood hazards

APPENDIX

MINISTRY OF ENVIRONMENT REGIONAL OFFICES

For marine fish farms located in Region 1 (off Vancouver Island and the Mainland Coast between Cape Caution and a line including Cortes Island, Rendezvous Islands, Read Island, Mandrelle Island, Sonora Island and East Thurlow Island), contact :

Regional Waste Manager,
Waste Management Branch,
2569 Kenworth Road, Nanaimo, B.C.
V9T 4P7

Phone : 758 - 3951

OR

Regional Conservation Officer,
Conservation Officer Service
2569 Kenworth Road, Nanaimo, B.C.
V9T 4P7

Phone : 758 - 3951

For marine fish farms located in Region 2 (off the Lower Mainland Coast from the International Border to Toba Inlet, and including the northern Gulf Islands), contact :

Regional Waste Manager,
Waste Management Branch,
15326 - 103A Avenue, Surrey, B.C.
V3R 7A2

Phone : 584 - 8822

OR

Regional Conservation Officer,
Conservation Officer Service
15326 - 103A Avenue, Surrey, B.C.
V3R 7A2

Phone : 584 - 8822

For marine fish farms located in Region 5 (off the Central Mainland Coast from Cape Caution to Milbanke Sound), contact :

Regional Waste Manager,
Waste Management Branch,
1011 - 4th Avenue, Prince George, B.C.
V2L 3H9

Phone : 565 - 6155

OR

Regional Conservation Officer,
Conservation Officer Service
1011 - 4th Avenue, Prince George, B.C.
V2L 3H9

Phone : 656 - 6140

For marine fish farms located in Region 6 (off the Northern Mainland Coast north of Milbanke Sound, and off the Queen Charlotte Islands), contact :

Regional Waste Manager,
Waste Management Branch,
3726 Alfred Ave., Smithers, B.C.
VOJ SNO

Phone : 847-7260

OR

Regional Conservation Officer,
Conservation Officer Service
3726 Alfred Ave., Smithers, B.C.
VOJ SNO

Phone : 847-7261